



A UNIT OF GENERAL SIGNAL

MODEL

1002-12PEX

S/N

RC3-700

312-385-9000

OPERATION and MAINTENANCE MANUAL

MP MASTER



MA34378

BLUE M ELECTRIC COMPANY, HIGH-LOW TEMPERATURE CHAMBERS
SINGLE STAGE - WATER COOLED

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MISCELLANEOUS

1.	Alco Thermo-Expansion Valves	
2.	Alco Solenoid Valves	No. 173-2A
3.	Alco Filter Driers	Bulletin No.200-2C
4.	A-P Crankcase Pressure Regulator	No. R-700A
5.	Penn Pressure Controls	#998-844-1 (Series 270-1272)
6.	Penn Water Regulating Valve	Series 246, #2746-9
7.	Corrosion Resistance of Stainless Steel	TB. 104
8.	Copeland Service Manual	
9.	Temperature Conversion Chart	

Date: October, 1966

GENERAL INFORMATION AND WARRANTY FOR BLUE M ELECTRIC COMPANY, HIGH-LOW TEMPERATURE CHAMBERS

FOREWORD

This manual is prepared to acquaint the operator with the equipment. A thorough understanding of the functions of the component parts of the chamber will assist the operator to attain proficiency of operation, and thus, produce test results compatible with the capabilities of the equipment supplied.

Blue M chambers are manufactured to the highest standards of the industry and are designed to give years of satisfactory service, if properly installed and maintained.

Schematic drawings, charts, etc., are included for the electrical wiring and refrigeration system along with other information for maintaining and servicing the equipment by a qualified refrigeration service mechanic having a thorough fundamental knowledge of the basic refrigeration principles. Should service be required, it is suggested that a company with previous experience in this type of work be selected. It is good practice to check with other users of test equipment to obtain the name of a competent service organization.

Due to the wide variety of equipment manufactured by Blue M and the always present problem of change in materials, these manuals are general in nature.

STORAGE AND SHIPPING

For storage or shipping of water cooled units in below freezing temperatures, the water cooled condensers, coils and water valves must be blown out with air. A charge of alcohol is then recommended for all water lines.

WARRANTY

The seller shall repair or replace, free of charge, such part or parts of the equipment sold that may prove defective in workmanship or material within one year from date of shipment. The warranty extended for parts does not include the replacement of refrigerant, oil, dehydrators and viewing windows. Defective parts must be shipped to the seller Freight Prepaid. Replacement or repaired parts shall be returned to the purchaser, Freight Collect. Labor to remove and re-install parts is the responsibility of the purchaser, unless otherwise noted on the contract covering this equipment.

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INSTALLATION PROCEDURE
FOR BLUE M ELECTRIC COMPANY, HIGH-LOW TEMPERATURE CHAMBERS

INSTALLATION PROCEDURE

1. Carefully remove the crate from the cabinet and examine the equipment for any possible shipping damages.
2. The test chamber should be located on a level floor, which has a suitable firm foundation to withstand the additional load of the test chamber and its contents. Sufficient clearance should be left completely around the test chamber to facilitate servicing and also to give proper air circulation, if air cooled. In portable machines, care should be exercised to have the machine level when in operation.
3. Loosen the shipping nuts on the four legs of the compressor until it floats freely.
4. Open all compressor service valves and the condenser receiver service valve. Tighten packing glands and replace valve caps, making sure the copper gasket is in each cap.
5. On water cooled units, attach water supply line to the pipe coupling, identified as "Water Supply", located to the back or side of the compressor section. The size of the supply line will be equal to or greater than the pipe size of this coupling and must carry at least 40 PSIG pressure at all times. It is recommended that a shut-off valve be placed in the water line ahead of the machine.
6. On water cooled units, attach water drain line to another pipe coupling, located alongside the "Water Supply". This line must be equal to or greater than the pipe size of this coupling and may be connected to a pressure drain or floor drain.
7. Connect proper power source to chamber. Consult data plate, located on chamber, for required voltage and connected load. Feed power supply through a separate fused safety disconnect switch, supplied by others, to the terminals on the power terminal block located in the electrical compartment on the chamber. Grounding can be accomplished by connecting a separate ground wire from the metal frame of the unit to a suitable ground, such as water pipe or conduit. As the unit is furnished completely internally wired, these are the only electrical connections necessary.
8. Self-contained test chambers have compressors and other refrigeration equipment completely connected and no further connections must be made other than the electrical and water connections as previously mentioned.



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9. Check blower motor rotation. This chamber is designed for a vertical air flow with air discharging from the top of the conditioning section and returning in the bottom. If unit is supplied for 3 phase operation, observe blower rotation. Reversing any two line leads will reverse a three phase motor.

10. Specifications

Consult specification data plate located on chamber for type refrigeration system, refrigerant charge, required water supply, voltage and connected load.

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CONTROL EQUIPMENT DESCRIPTIONS
FOR VERSA-RANGE TEST CHAMBERS

In order to properly understand this chamber, the operator should be familiar with the various items which make the chamber perform as it was designed to. The following is a brief outline of the components used in this system and the functions of each.

1. POWER-O-MATIC 60 TEMPERATURE CONTROLLER

Controls the temperature within the test space. Instructions covering this instrument should be referred to and read in detail before placing chamber into operation.

2. READY-READ TEMPERATURE INDICATOR

Located on the control panel, monitors test space temperature. Refer to additional instructions in this manual for detailed information regarding calibration.

3. VOLTMETER

Indicates the voltage applied to the chamber air heaters from the Power-O-Matic 60 saturable reactor control.

4. MAIN CIRCUIT BREAKER

Completes the power to the blower motor, compressor, air heaters, and control transformer. In the event of a short circuit, circuit breaker will trip and disconnect power to the chamber. Control voltage is 120 volts furnished by means of a control transformer supplied from line voltage. With the circuit breaker in the closed position, the control circuit is energized thereby allowing the blower motor to run. The air heater is interlocked with the blower circuit through a set of contacts which prevent the air heaters from operating unless the blowers are in operation.

5. COOLING SWITCH

Starts the refrigeration equipment, providing all the other contacts are calling for the cooling operation. This switch also completes the control circuit to the cooling capacity switch.



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6. COOLING CAPACITY SWITCH

Places the hot gas by-pass capacity control valve in operation by energizing the hot gas solenoid valve. With the hot gas capacity control valve in operation, the refrigeration capacity of the system is reduced to approximately 50% of full rating. This switch is intended for use when maintaining steady state conditions in the range of approximately 0°F. to +120°F.

7. INTERIOR LIGHT SWITCH (OPTIONAL)

Controls the chamber light. During low temperature test, it is recommended that the light be used only as needed for viewing items under test, thereby reducing the introduction of additional heat.

8. CRANKCASE PRESSURE REGULATING VALVE

Limits the maximum low side pressure at the compressor inlet, to provide automatic motor overload protection. At conditions of overload, the valve modulates to prevent suction gas pressures at the compressor inlet above that for which the valve is adjusted. When the condition of overload has passed and the suction pressure drops below the valve setting, the valve assumes a wide open position during the balance of operation.

9. R-502 HIGH PRESSURE CUT-OUT

Is in series with the compressor. Pressures higher than the setting will cause the compressor to stop. When the discharge pressure goes down to the differential of the control, the compressor will again start.

10. SUCTION LINE DESUPERHEATER

Systems equipped with hot gas capacity control are supplied with a separate desuperheater expansion valve to meter liquid refrigerant into the suction line in order to maintain the temperature of the refrigerant gas returning to the compressor within allowable limits. This item is extremely important to compressor life.



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CALIBRATING INSTRUCTIONS

BLUE M MEMORY RING DIAL SYSTEM

(PATENTED)

The Memory Ring Dial assembly allows calibration at all temperatures with pin point accuracy and extreme ease. The inherent ability of this control system to reproduce an exact temperature when control dial is returned to the same setting justifies the few minutes spent to calibrate it.

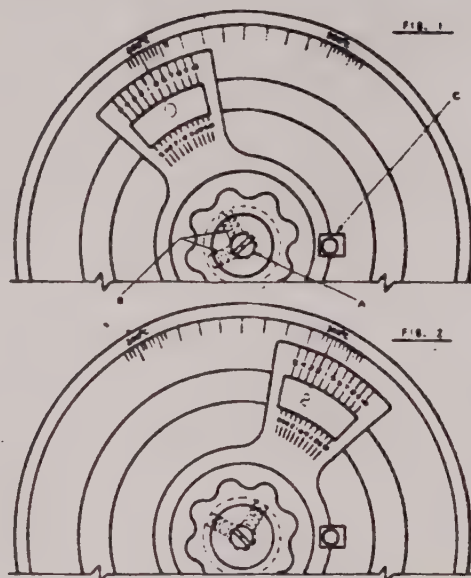
Dials are factory calibrated to a mid-range temperature when zero mark is aligned with the temperature graduation. (As shown in FIG. 1, this dial is calibrated to produce a chamber temperature of 200°C. when set at zero.)

Movable pointer has a dial lock (Item C, FIG. 1) which is provided to prevent the control from being accidentally changed. Loosen thumb screw and slip pointer lock assembly out. Lock assembly may be secured in four (4) positions, or every 90° around the dial. This allows the movable pointer to rotate almost a full 360°. Dial lock must be secured in fixed holder or it will rotate with pointer instead of locking it.

When temperature control is factory installed, STEPS I and II may be omitted. STEPS I and II only apply when control is added to an existing piece of equipment.

STEP I - Using a separate means of indication, (thermometer, recorder, etc.) operate unit at a mid-scale temperature. In case of example shown in FIG. 1, 200°C., stabilize unit at desired temperature as indicated on separate indicating instrument.

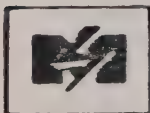
STEP II - After unit has stabilized at set temperature, carefully loosen control knob set screws. (Item B, FIG. 1) These screws should remain in contact with control shaft and only be loose enough to slip forward or backward on control shaft. Loosen pointer locking screw. Item A, FIG. 1. There is a Star Lock washer between plastic knob and aluminum pointer. Screw "A" must be loose enough to allow movement of pointer. Holding knob so that the Control Shaft cannot move, slip pointer until the zero mark is aligned with set temperature. Retighten dial lock screw "A" and set screws "B". Dial is now calibrated to set temperature.



STEP III - There are graduated reference numbers on pointer extending in both directions from zero mark which are correction factors for calibration error. Example shown in FIG. 2, illustrates calibration procedure at other temperatures. When control setting is raised so that zero mark is aligned with 300°C. graduation, indicator shows that a temperature less than 300°C. is produced. Move control pointer slightly to the right (clockwise) to raise the temperature. When temperature indicator reads exactly 300°C., note that the 300°C. graduation is aligned with correction factor No. 2.

STEP IV - White ring on dial is painted to receive pencil or ball point pen. Write the correction factor (2) directly under 300°C. graduation. Now, whenever control is returned to 300°C., the correction factor (2) will appear in pointer window, automatically indicating proper control setting to obtain exactly 300°C. All other points are calibrated in the same manner. Dial can be calibrated during normal use by marking correction factor each time a new temperature is used.

If there are any further questions, feel free to contact the factory at any time.



BLUE M Electric Company

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MANUFACTURERS AND ORIGINAL DESIGNERS OF CONSTANT TEMPERATURE CONTROLLED EQUIPMENT.

CALIBRATING INSTRUCTIONS FOR BLUE M READY-READ TEMPERATURE INDICATOR

INSTRUCTION NO. 1-202-4

The Ready-Read Temperature Indicator is actuated by a liquid-filled thermal system employing a high torque bourdon spiral. There are no gears, hair springs, pinions or multiplying mechanisms to detract from its ruggedness and reliability. The dial arc is a full 270° on a 3" diameter scale and indicator accuracy is $\pm 2\%$.

The Ready-Read Thermometer eliminates the irritation and expense of broken glass thermometers. In our judgement, it is more accurate than most small dial thermometers and more convenient than pyrometers with thermocouples. Temperature graduations are easily read and are in both Centigrade and Fahrenheit.

The following instructions explain the use and calibration of Ready-Read Thermometers. In addition, pertinent background information on the liquid-filled thermal system is given.

GENERAL INFORMATION

BASIC READY-READ THERMAL SYSTEM

The basic Ready-Read thermal system is shown in Figure 1. The entire system is filled with a liquid that expands with an increase in temperature. The sensing bulb is a fine bore tubing immersed in the work chamber to measure the temperature. The capillary is also a fine bore tubing that merely "transmits" pressure changes from the sensing bulb to the "Bourdon tube". The Bourdon tube converts pressure changes into rotary motion, thus providing indication on the calibrated scale.

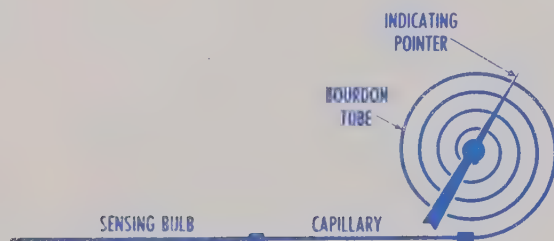


FIG. 1

AMBIENT TEMPERATURE INDICATION AND COMPENSATION

DO NOT ADJUST AMBIENT INDICATION WHEN UNIT IS FIRST RECEIVED AND INSTALLED REGARDLESS OF POINTER INDICATION.

The Ready-Read Temperature Indicator is installed on the unit and then calibrated after the unit has operated for at least one (1) hour. This procedure compensates for ambient rise within the control compartment due to normal heating of electrical components (motors, coils, saturable reactors, etc.). Since the Ready-Read is calibrated with the capillary exposed to relatively high control compartment temperatures, ambient indication will be lower than true ambient until the unit has operated for at least one (1) hour.

NOTE: Because the Ready-Read Temperature Indicator is not a "total immersion" temperature measuring device, it cannot be used to indicate varying "room" temperatures. Only the sensing bulb must be immersed in the medium to be measured.

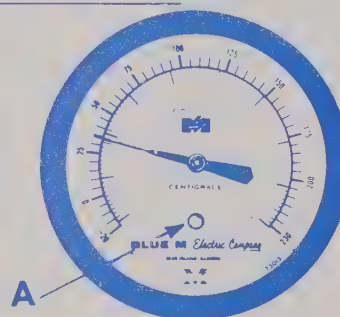
The Ready-Read Temperature Indicator automatically compensates for ambient temperature variations experienced at the "case". Compensation is accomplished by a built-in bimetal opposing the rotation of the Bourdon tube.

CALIBRATION

Attach thermocouple of calibrating instrument directly to the Ready-Read sensing bulb. Turn unit "on" and allow to operate for one (1) hour at its lowest controllable temperature. NOTE: For units having sub-ambient temperature capabilities, use ambient for the zero adjustment.

CENTIGRADE - OUTSIDE - BLACK

FAHRENHEIT - INSIDE - RED



ZERO ADJUSTMENT

1. Remove "Bezel" and glass cover from Ready-Read Temperature Indicator. Removal made by prying outward with a small screwdriver, etc., around the perimeter of the chrome plated ring.
2. Rotate adjusting screw "A" until the indicated temperature corresponds to the temperature shown by the calibrating instrument.
3. The zero adjustment is now complete.

SPAN ADJUSTMENT

1. Set unit for an operating temperature near maximum. (If unit maximum temperature is $+343^{\circ}\text{C}$., set for $+300^{\circ}\text{C}$.. If maximum is $+200^{\circ}\text{C}$., set for $+200^{\circ}\text{C}$., etc.)

NOTE: For units having sub-ambient temperature capabilities, the span adjustment may be made on either side of ambient temperature. If greater accuracy is desired at low temperature, set unit for an operating temperature near its minimum. (If unit minimum temperature is -100°F ., set for -100°F .. If minimum is -40°F ., set for -40°F ., etc.)

2. Allow unit to operate at this high temperature for one (1) hour.
3. If the temperature shown on the Ready-Read Temperature Indicator is lower than the temperature shown on the calibrating instrument, the "span" is too short.
Correct by pushing sensing bulb farther into the work chamber.
4. If the temperature shown on the Ready-Read Temperature Indicator is higher than the temperature shown on the calibrating instrument, the "span" is too long.

Correct by pulling the sensing bulb farther out of the work chamber.

Adjust the sensing bulb, in or out as required, approximately $\frac{1}{2}$ ". Allow 10 to 15 minutes for the Ready-Read Temperature Indicator to stabilize. Continue this procedure until the Ready-Read indicates the correct temperature in accordance with calibrating instrument.

The span is now properly adjusted. Reseal into position with a high temperature material such as General Electric RTV Sealant.

NOTE: Changing the immersion depth has a marked effect on temperature indication at the high end of the scale. However, at the low end the effect is negligible. Referring to Figure 2, this is easy to understand.

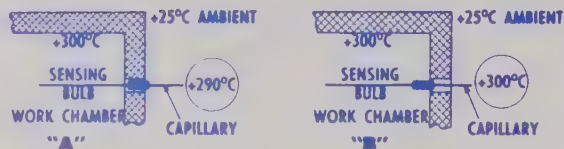


FIG. 2

At a temperature of +200°C. or +300°C., additional immersion exposes more of the sensing bulb to this high temperature. Indication therefore increases. At a low temperature (+25°C.), additional immersion accomplishes nothing, since the chamber's temperature and ambient temperature are the same.

OPERATING INSTRUCTIONS FOR BLUE M
HIGH-LOW TEMPERATURE CHAMBERS
(SINGLE STAGE)

Blue M environmental test chambers simulate a wide range of temperatures while maintaining precision temperature control. This requires compressor capacity control for satisfactory system performance.

Blue M offers a non-cycling, continuous operation refrigeration system, with a hot gas by-pass compressor capacity control system, used in conjunction with Power-O-Matic 60 Proportioning Saturable Reactor to produce straight line control of temperature.

Power-O-Matic 60 Reactor Controller offers inherent stability due to its non-cycling, proportional power input method of control. Exact amounts of power required to hold the temperature are applied to heating elements, changing only in response to load changes and line voltage changes. It is comprised of components whose characteristics do not change with age or usage. Minimal deviation from a set temperature will be a slight drift created by severe line voltage change and ambient temperature variations.

CONSTANT TEMPERATURE TESTS

To maintain a constant temperature in chamber, it will be necessary to bring temperature to set point and then add only heat required to maintain set point temperature. If set point is at a temperature below ambient, refrigeration must be used to remove heat that passes into chamber, heat added by fan and any heat dissipation from the product. Only the amount of refrigeration necessary to hold a given control point is desired. If set point is at a temperature above ambient, heat must be added to offset heat loss through chamber walls; however, only the amount of heat necessary to hold the controlled setting. These test procedures are recommended.

I. Low Temperature Test

Under this heading are considered only tests where full cooling capacity is desired to maintain required temperature. Temperature range is from minus 40°F. to approximately 0°F.

- A. Turn main circuit breaker "ON". Power to entire chamber is supplied thru this circuit breaker. Blower motor will automatically start when circuit breaker is on.

- B. Set control to desired temperature. Turn counterclockwise to lower temperature. Voltage impressed across heating elements can be observed on voltmeter. Refer to enclosed instructions for calibration.
- C. Turn cooling switch to "ON" position. This will provide full cooling capacity of refrigeration system.

Equipment is now in operation.

II. Intermediate Temperature Tests

Under this heading are considered only where a limited amount of cooling is desired to maintain required temperature. This temperature range is from 0°F. to approximately plus 120°F.

- A. Turn main circuit breaker to "ON" position.
- B. Set control to desired temperature. Refer to enclosed instruction for calibration.
- C. Turn cooling switch to "ON" position.
- D. Turn cooling capacity switch to "ON" position. This switch places in operation hot gas by-pass capacity control valve, reducing capacity of refrigeration system to approximately fifty percent of full rating.

Equipment is now in operation.

III. High Temperature Tests

Under this heading are tests above approximately plus 120°F., where only heating equipment is required to maintain desired temperature.

- A. Turn main circuit breaker to "ON" position.
- B. Set control to desired temperature. Turn clockwise to raise temperature. Voltage impressed across heating elements can be observed on voltmeter. Refer to enclosed instruction for calibration.

Equipment is now in operation.

IV. RANGE-LOCK SETTING

This chamber is equipped with an overtemperature protection device. Once set, voltage to heating element CANNOT BE RAISED above a predetermined value EVEN IF CONTROL KNOB IS TURNED or if COMPLETE LOSS OF CONTROL BELLOWS IS EXPERIENCED, due to ruptured thermal system.

Since output voltage is determined by position of "I" lamination armature of inductor coil, it can be seen that if armature is mechanically "locked" after it has been positioned by bellows, voltage cannot be raised even if bellows is removed entirely. Setting procedure is as follows:

- A. Allow oven to stabilize at operating temperature.
- B. Remove dust cover from access hole on wiring panel.
- C. Insert a screw driver thru access hole and engage slotted shaft (A).
- D. Back shaft out (counterclockwise) very slowly, observing voltmeter while doing so.
- E. When stop disc (B) touches armature (C), voltage will immediately drop from its initial reading because you will be closing the armature manually.
- F. As soon as voltmeter drop is observed, stop turning adjusting screw. Turn adjusting screw back (clockwise) approximately $\frac{3}{4}$ turn so that stop disc (B) is not in actual contact with armature (C).

IMPORTANT:

If armature is not free to move a small amount, control will be unable to compensate for a line voltage drop.

- G. Maximum voltage is now permanently fixed at a value slightly higher than maximum requirement to maintain set temperature. In event of bellows failure, armature can only fall back as far as mechanical stop. Temperature will be maintained within confines of line voltage variations.
- H. IMPORTANT:
Since temperature variation is now dependent upon line voltage fluctuation, Range-Lock should be set at a time of day when line voltage is at its highest level. This insures a limitation on maximum temperature that will be reached in event of failure.
- I. If a temperature recorder is available, it is recommended that a 24-hour test run be made with Range-Lock set and control deliberately turned up to establish what maximum drift of temperature will occur in event of bellows failure. Line voltage regulation varies considerable throughout the country.

REFRIGERATION SYSTEM
FOR BLUE M HIGH-LOW TEMPERATURE CHAMBERS
(SINGLE STAGE)

GENERAL DESCRIPTION

This chamber consists of a single stage refrigeration system, using a thermostatic expansion valve. Compressor discharges refrigerant vapor under pressure to an oil separator where oil is trapped out and returned to compressor. Refrigerant vapor then passes into condenser, either air or water cooled, where heat is removed and vapor changed to a liquid. From condenser receiver, liquid flows through receiver liquid line valve, a liquid sight glass, a filter drier, through a liquid line solenoid valve and into high side of expansion valve. Expansion valve feeds low pressure liquid refrigerant to finned cooling coil, where heat is absorbed changing liquid to a vapor. Vapor then enters suction line and passes through a crankcase pressure regulating valve to suction side of compressor thus completing cycle.

Chambers supplied with a capacity control system are equipped with an electrically operated hot-gas by-pass capacity solenoid valve, a suction line accumulator and a separate desuperheating expansion valve. In operation, hot gas by-pass valve is installed between compressor discharge and low side of refrigeration system, with a solenoid valve installed ahead of hot gas by-pass valve. When solenoid valve is in "closed" position, system is operating at full capacity. When solenoid valve is in "open" position, a reduced cooling capacity of approximately fifty percent will be produced. Due to high temperature of hot gas, a desuperheating expansion valve is necessary to meter liquid refrigerant into suction line and mix it thoroughly with by-passed hot gas in order to keep temperature of refrigerant vapor returning to compressor within allowable limits. A suction line accumulator serves as the mixing chamber and protects compressor from liquid flood-back.

This system contains all safety devices usually encountered on commercial applications, which includes a high pressure cut-out control, thermal motor overload protection and a high pressure relief valve. On water cooled units, there is also an automatic water regulator to control flow of water to condenser in accordance with requirements.

PUMPING DOWN THE SYSTEM

To pump down system, close receiver outlet service valve, start compressor and continue running until low side gauge pressure reads "0" P.S.I.G.

refrigerant charge has then been condensed and is being held between compressor discharge service valve and receiver outlet valve.

VAPOR CHARGING SYSTEM

In many cases, a low refrigerant charge is caused by an obvious leak. Where there is no possibility that air and moisture have entered system, it is only necessary to repair leak and add refrigerant to system. Addition of refrigerant is carried out by vapor charging. Following procedure should be taken:

1. Back-seat suction service valve.
2. Loosely connect line from low side of tap of service manifold to suction service valve gage port.
3. Connect line from center tap of manifold to upright refrigerant cylinder.
4. Back seat discharge service valve.
5. Loosely connect line from high side tap of service manifold to discharge service valve gage port.
6. Purge vapor from cylinder up to compressor discharge valve.
7. Tighten high side service valve connection at gage port.
8. Purge vapor from cylinder up to compressor suction valve.
9. Tighten low side service valve connection at gage port.
10. Turn discharge service valve 1/4 turn off back seat.
11. Turn suction service valve 2 complete turns off back seat.
12. Pressurize system to full cylinder pressure and make final leak check.
13. Start compressor and wait until head pressure and suction pressure stabilize. Admit refrigerant from cylinder by adjusting cylinder valve to maintain a refrigerant vapor flow at a 10 to 15 pound pressure differential.

From time to time, note suction pressure with cylinder valve closed.



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From time to time, note discharge pressure to see that it does not rise above what would normally be expected under usual operating conditions. For air cooled systems, ambient temperature plus 30°F. converted to refrigerant saturation pressure should approximate discharge pressure.

14. Correct refrigerant charge can be checked easily by viewing sight glass, installed in liquid line, and observing compressor operation. If system is short of refrigerant, flash gas, in form of bubbles, can be seen rushing through glass. When sight glass indicates a solid liquid flow, system is charged. You may continue to add a small holding charge to system for reserve, however, make sure total charge does not exceed liquid receiver capacity.
15. When system is properly charged, back seat suction and discharge service valves and bleed pressure from both gage lines through manifold charging port.
16. Replace cap on cylinder valve and install flare plugs in open ends of charging and gage lines. Replace plugs in gage ports of service valves.

NOTE: If cylinder pressure drops too low for charging before job is completed, place cylinder in a pan or bucket of warm water between 80°F. to 110°F. Never apply heat to cylinder with a torch or never heat cylinder over 125°F.

LEAK TESTING

Leak testing may be done by same methods employed on any commercial installation. Use either a Halide torch or electronic leak tester. Extra care in leak testing will save both time and money.

OIL

Motor compressor assembly is hermetically sealed and should be checked by a competent refrigeration serviceman periodically. Oil recommended to be used for compressor is Suniso #3G. Only enough oil should be added to bring oil level to recommended level. This can be determined from compressor manual. Excessive amounts of oil in system tend to reduce heat transfer and increase temperature differential of evaporator and condenser.

MAINTENANCE

This system can be serviced with same tools, leak detector, gages and accessories as are required for normal commercial refrigeration service. Service this system with same care shown in good commercial practice. Remember that components and service methods are the same. Pressures are in normal operating range of standard commercial installation. Studying refrigeration schematic and information contained herein will enable service engineer to carefully and accurately analyze conditions for easiest maintenance and care. It is recommended that equipment be given regular checks for leaks and for oil level in compressor. Time between tests and checks should be determined somewhat from frequency of use and be in accordance with general commercial practice, which calls for at least two inspections per year.

PRECAUTIONS

1. Make certain only competent refrigeration servicemen perform inspections or service to this equipment.
2. If unit is air cooled, clean air cooled condenser every 30 days, or as often as required.
3. On water cooled units, make certain water is turned on to unit before starting any tests.
4. If unit is water cooled, make certain all water is removed from system, if unit will be moved or stored in temperatures below 32°F.
5. Make certain to loosen hold down nuts and see that compressor floats freely on mounting springs when installing or re-locating unit.
6. Make certain to tighten shipping bolts or hold down nuts before shipping or re-locating machine.

PRESSURE TEMPERATURE RELATIONS

<u>Degrees Fahrenheit</u>	<u>R-12</u>	<u>R-22</u>	<u>R-502</u>	<u>R-13</u>
120	157.6	259.9	280.3	
110	136.4	226.3	245.8	
100	117.2	195.9	214.4	
90	99.8	168.4	185.8	
80	84.2	143.6	159.9	520.8
70	70.2	121.4	136.6	458.7
60	57.7	101.6	115.6	402.3
50	46.7	84.0	96.9	351.2
40	37.0	68.5	80.2	304.9
30	28.5	54.9	65.4	263.2
20	21.0	43.0	52.5	225.7
10	14.6	32.8	41.1	192.1
0	9.2	24.0	31.2	162.1
- 5	6.7	20.0	26.8	148.7
- 10	4.5	16.5	22.8	135.4
- 15	2.4	13.2	19.0	123.5
- 20	0.6	10.1	15.5	111.7
- 25	* 2.3	7.4	12.3	101.3
- 30	* 5.5	4.9	9.4	90.9
- 35	* 8.4	2.7	6.7	81.8
- 40	* 11.0	0.5	4.3	72.7
- 45	* 13.3	* 2.6	2.1	64.6
- 50	* 15.4	* 6.2	0.0	57.0
- 55	* 17.3	* 9.1	* 3.6	50.0
- 60	* 19.0	* 12.0	* 7.0	43.5
- 65	* 20.5	* 14.4	* 10.0	37.5
- 70	* 21.8	* 16.6	* 12.6	32.0
- 75	* 23.0	* 18.5	* 15.0	27.9
- 80	* 24.1	* 20.2	* 17.1	22.3
- 85	* 24.9	* 21.6	* 19.0	18.1
- 90	* 25.7	* 23.0	* 20.6	14.2
- 95	* 26.4	* 24.1	* 22.1	10.7
-100	* 27.0	* 25.0	* 23.3	7.5
-105	* 27.4	* 25.9		4.8
-110	* 27.9	* 26.6		2.1
-115	* 28.2	* 27.2		* 0.2
-120	* 28.6	* 27.7		* 4.5
-125	* 28.8	* 28.1		* 8.0
-130	* 29.1	* 28.5		* 11.4
-135		* 28.8		* 14.1
-140		* 29.0		* 16.8
-145		* 29.2		* 18.8
-150		* 29.4		* 20.8

* Inches of Vacuum



A UNIT OF GENERAL SIGNAL
BLUE ISLAND, ILLINOIS 60406

Date: October, 1966Page: 1 of 2

MAINTENANCE AND GENERAL NOTATIONS
FOR BLUE M ELECTRIC COMPANY, HIGH-LOW TEMPERATURE CHAMBERS

Blue M chambers are designed and manufactured to give years of dependable service, if properly installed and maintained. Normal care should be exercised when using the equipment. It is recommended that a maintenance program be set up whereby the equipment is checked at regular intervals to help maintain performance and reveal anything which needs adjustment or servicing.

1. Refrigeration System

These systems can be serviced with the same tools, leak detector, gauges and accessories as are required for normal commercial refrigeration service. Studying the refrigeration schematic and information contained herein will enable the service engineer to carefully and accurately analyze conditions for easiest maintenance and care. It is recommended that the equipment be given regular checks for leaks and for oil level in the compressors. The period between test and check should be determined somewhat from the frequency of use, and be in accordance with general commercial practice which calls for at least two inspections per year.

2. Refrigeration Oil

The oil recommended to be used for the compressor is Suniso #3G. Only enough oil should be added to bring the oil level to the recommended level. Excessive amounts of oil in the system tend to reduce the heat transfer and increase the temperature differential of the evaporator and condenser.

3. Blower Motor

In general, the external blower motors have sealed ball bearings, lubricated with silicone grease and do not require any additional lubrication.

If the blower motor is supplied with oil cups, the motor should be oiled with a few drops of NO. 20 Motor Oil, once a month.

4. Viewing Window

In any chamber in which there is a multipane glass window, a quick heat-up in temperature has been known to cause the glass to break. It is suggested that the chamber be brought to ambient temperature first and allowed to remain at that temperature for a period, before continuing the rest of the heat-up.

5. Power-O-Matic 60 Control

This control system is simple, extremely rugged and virtually maintenance free. Any electrical component failure will result in "cut-off" of reactor current. Inductor coil, reactor, transformer, rectifiers, capacitors and heating elements are all static devices, non-moving and non-wearing. If control system does malfunction, rectifier bridge should be checked for D.C. output. Silicon rectifiers can be damaged by line voltage transients. Replacement may be made by removing four screws holding bakelite panel to rear of control compartment. Maximum D.C. voltage should be 30V to 35 V to the reactor. For additional information please refer to Power-O-Matic 60 section in this manual.

6. Recording and Programming Instruments

The manufacturer's instruction manual covering these instruments should be referred to for detailed information regarding their operation and maintenance.

7. Precautions

- a) Make certain only competent refrigeration servicemen perform inspections or service to this equipment.
- b) Clean out all water line strainers to the unit once a month, or as often as required.
- c) Make certain water is turned on to the unit before starting any tests.
- d) Make certain all water is removed from the system, if the unit will be moved or stored in temperatures below plus 32°F.
- e) Clean air cooled condenser every 30 days, or as often as required.
- f) Make certain to loosen hold down nuts and see that the compressors float freely on the mounting springs, when installed or re-locating the unit.
- g) Make certain to tighten shipping bolts or hold down nuts before shipping or re-locating machine.

BLUE M ELECTRIC COMPANY
138th & CHATHAM STREETS
BLUE ISLAND, ILLINOIS 60406

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55

RP-345-3-4A

240V/3ph/60cy

VOLTAGE:

FTBR-12-15WS-DBF

MODEL NUMBER

R-20-67

#22 added

Rev."A"

* PARTS NOT SHOWN.

Prices subject to change without notice. Parts shipped F.O.B. Blue Island, Illinois.
When ordering parts, give MODEL NO., SERIAL NUMBER, VOLTAGE and PART NO.

ITEM NO.	DESCRIPTION	PART NUMBER	NO. REQD.
1	Motor Compressor	R12B-05	1
2	Discharge Vibration Absorber	Included In	Above
3	Charging Valve	Included In	Above
4	Condenser Receiver	Included In	Above
5	Water Regulating Valve	Included In	Above
6	Receiver Shut-Off Valve	Included In	Above
7	Pressure Relief Valve	Included In	Above
8	Liquid Indicator	R42-02	1
9	Filter Drier	R16-06	1
10	Liquid Line Solenoid Valve	R43A-03	1
11	Thermo Expansion Valve	R54A-07	1
12	Suction Vibration Absorber	R61-06	1
13	High Pressure Cut Out Control	R37B-01	1
14	Oil Separator	R36-02	1
15	Evaporator	C351-4	1
16	Accumulator	R01-03	1
17	Crankcase Pressure Regulator	R13C-02	1
18	Hot Gas By-Pass Solenoid	R43A-04	1
19	Hot Gas By-Pass Valve	R66-07	1
20	Liquid Line Solenoid Valve	R43A-03	1
21	Thermo Expansion Valve	R54A-02	1
22	Check Valve	R06-02	1
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SUPPLEMENTARY WIRING DIAGRAM & PARTS LIST

WD 4936

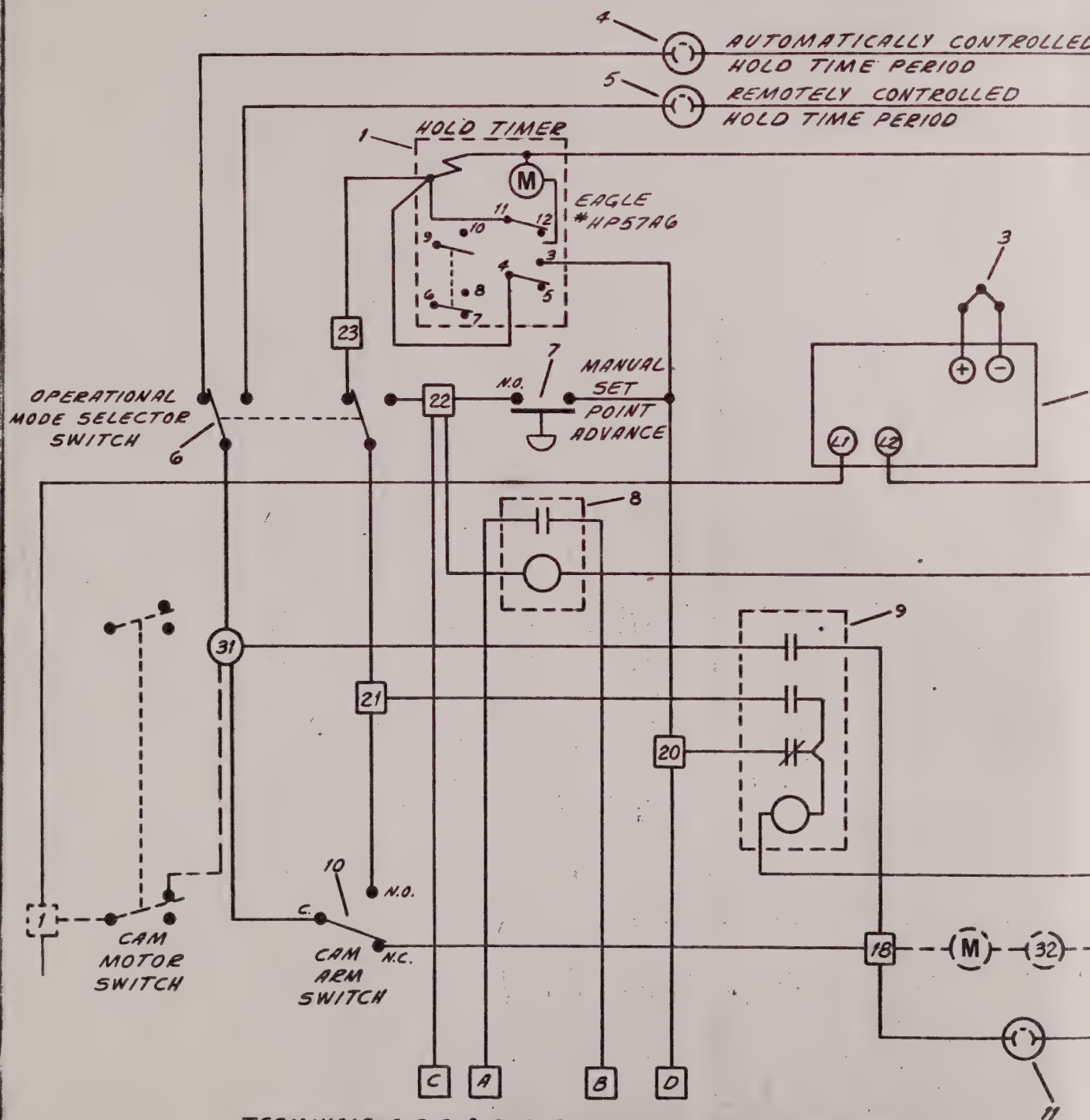
USE WITH MASTER WD 911

JOB NUMBER

MODEL NO. 1002-3PBX

DATE 4-25-74

CUSTOMER NAVAL RESEARCH



TERMINALS A, B, C, & D ARE PROVIDED FOR CONNECTION TO THE CUSTOMERS REMOTE CONTROL CIRCUIT.

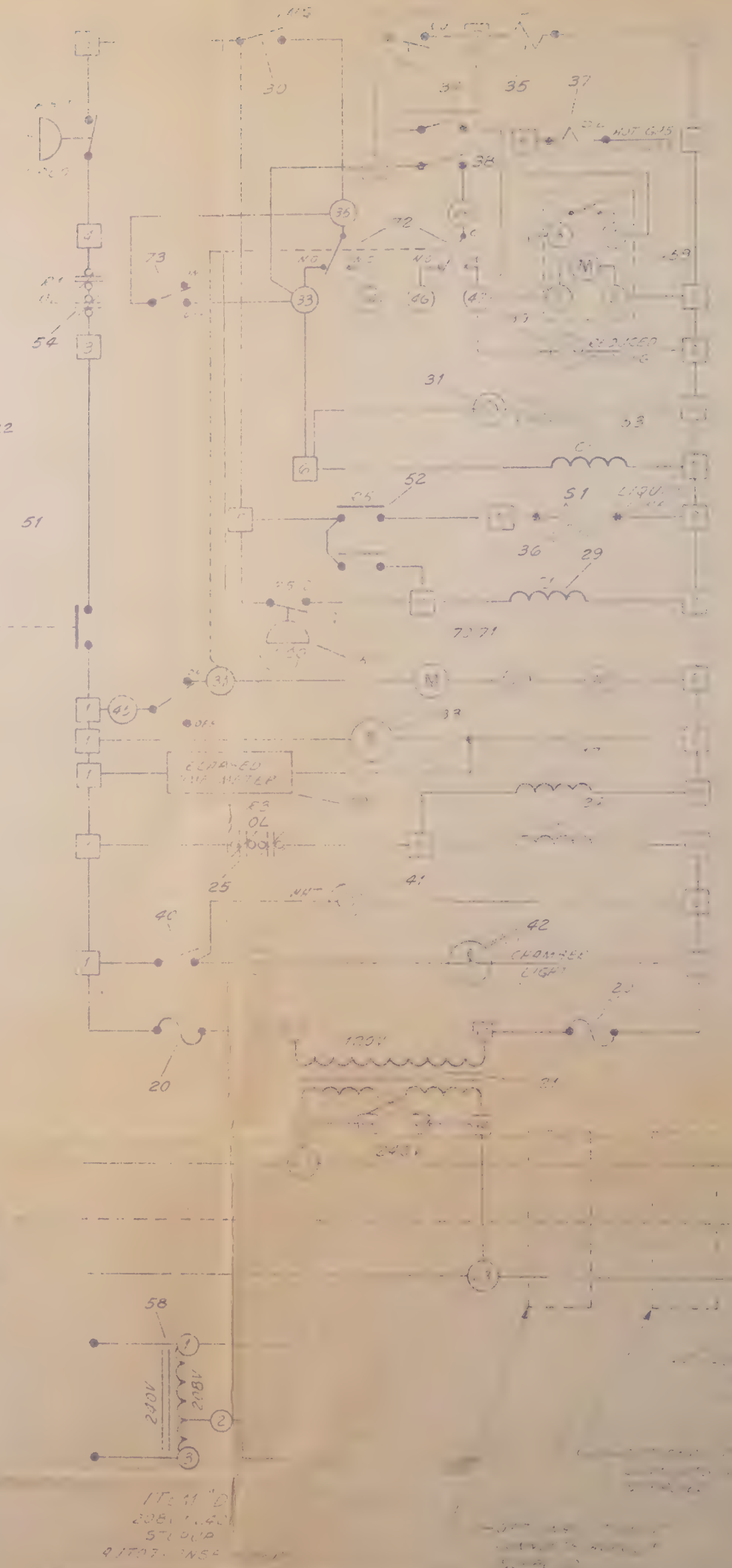
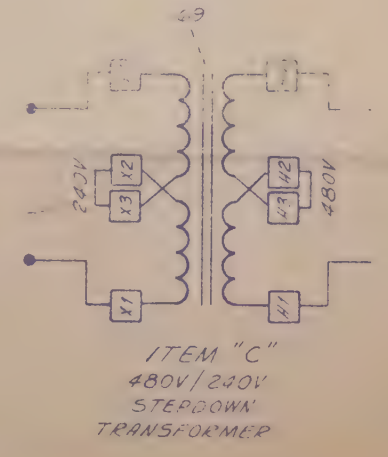
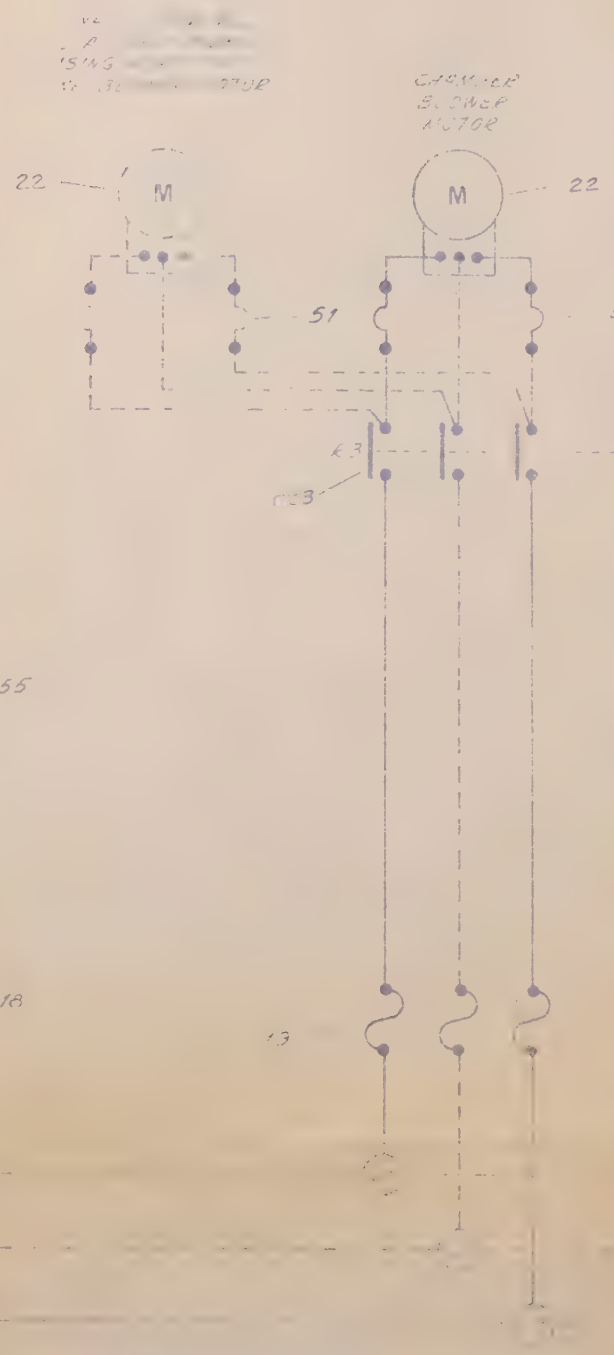
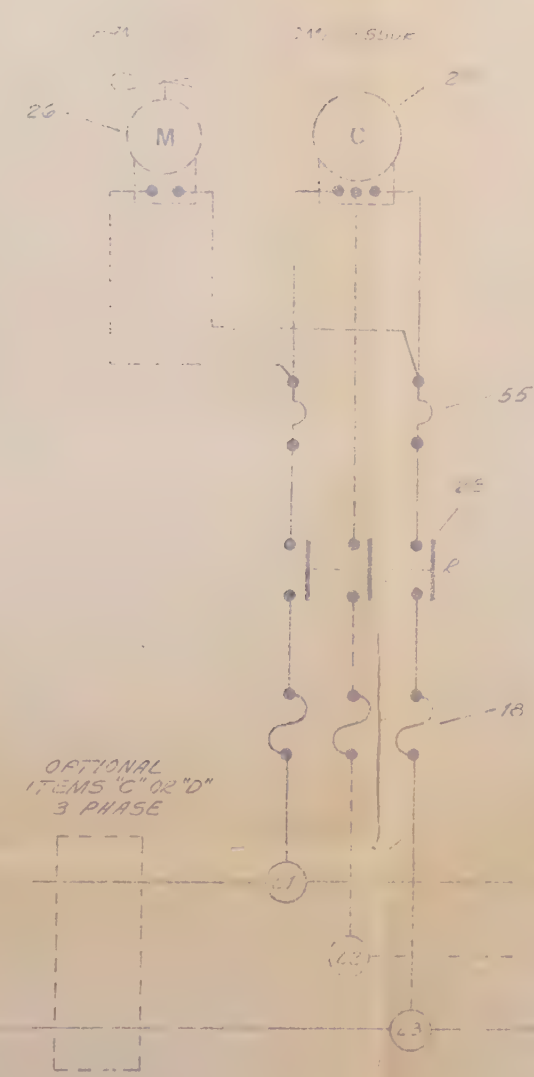
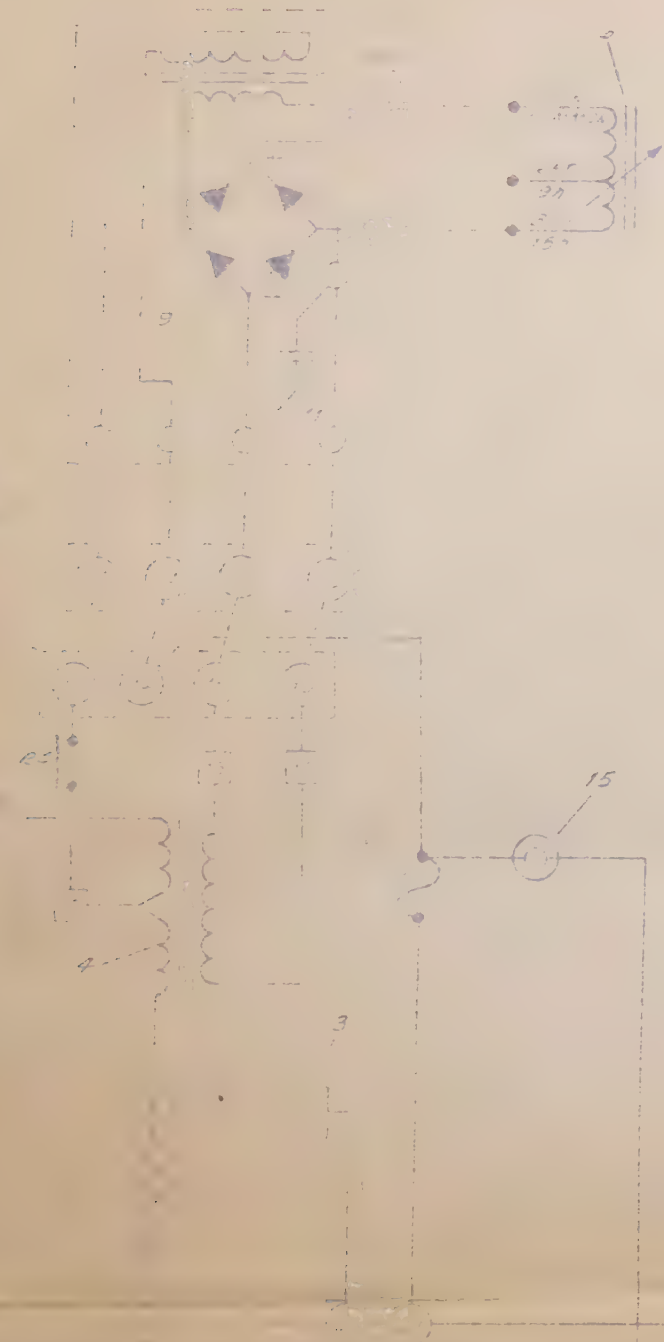
--- EXISTING WIRING
 — NEW WIRING

ITEM	DESCRIPTION	PART NO.	QUANTITY
1	Hold Timer	Eagle #HP57A6	1
2	Recorder	C02B-1-1	1
3	Thermocouple	C11B-2	1
4	Automatic Mode Pilot Light	E06B-1	1
5	Remote Mode Pilot Light	E06B-1	1
6	Mode Selector Switch	E16A-2	1
7	Manual Advance Pushbutton	E16C-1	1
8	Remote Mode Relay	E02C-1	1
9	Cam Motor Latching Relay	E02C-6	1
10	Cam Arm Microswitch	Supplied W/#74	
11	Cam Motor Pilot Light	E06B-1	1

NOTES:

1. Continuity across terminals A and B will be completed when the cam pin activates the cam arm microswitch caused by the rotation of the cam.
2. Completing a circuit across terminals C and D by a momentary contact will automatically advance the cam to the next temperature set point. The cam will stop rotating and hold at the cam pin location.
3. A panel mounted, manual set point advance pushbutton switch is provided to override the remote control, if so desired.
4. Temperature set point hold periods can be omitted for a specific program by removing the individual pin, or pins, from the cam.





1002-3P SERIES, 1 PHASE OR 3 PHASE	
DRAWING NO. WD-911	REV. 1

BLUE IS

BLUE IS Electric Company

Company Headquarters: BLUE ISLAND, ILLINOIS 60008

MODEL NUMBER 1002-12 PG
VOLTAGE 480V/3-PH/60-HZ
MAX TEMPERATURE -40°C TO +93°C
MAX WATTS 5.5 (TOTAL LOAD)
INTERIOR DIMENSIONS 36W X 24D X 24H

PWD-1200-911-2

(PAGE 2)

THIS PARTS LIST TO BE
USED WITH WIRING DIAGRAM
WD-911B

ITEM	DESCRIPTION	PART NUMBERS	QTY
1	OVERCUT BREAKER AMP	E160	1 SET
2	CHAMBER AIR HEATERS	A121-707A	1
3	VOLUNTARY WITH RESISTOR	E09-3	1
4	SATURABLE REACTOR	E13-7	1
5	CONTROL CIRCUIT POWER SUPPLY	E15A-2-2	1
6	TEMPERATURE CONTROL	C03A-5-21	1
7	BELLOWS ASSEMBLY	C11A-4	1
8	CONTROL TRANSFORMER	SUPPLIED W/ITEM #5	
9	BRIDGE RECTIFIER	SUPPLIED W/ITEM #5	
10			
11	CAPACITOR	SUPPLIED W/ITEM #5	
12	POWER SUPPLY PLUG	E19A-5	1
13	POWER SUPPLY SOCKET	SUPPLIED W/ITEM #5	
14	PANEL FUSE	E04R-1	1
15	MAIN PILOT LIGHT	E06B-2	1
16	RELAY	E02C-1	1
17	RELAY COIL	SUPPLIED W/RELAY	
18	COMPRESSOR FUSE	E04R	3
19	CHAMBER BLOWER FUSE	E04R	3
20	CONTROL CIRCUIT FUSE	E04A-2	2
21	CONTROL TRANSFORMER 1/120V 500VA	E17B-2-3	1
22	CHAMBER BLOWER MOTOR 1/3 HP	E17B-2-3	1
23	CHAMBER BLOWER MOTOR STARTER	E11A-1	1
24	CHAMBER BLOWER MOTOR STARTER COIL (C3)	SUPPLIED W/STARTER	
25	CHAMBER BLOWER OVERLOAD RELAY	SUPPLIED W/ITEM #22	
26	CONDENSATOR FAN MOTOR	NOT APPLICABLE	
27	COMPRESSOR 1 1/2HP 240V/3-PH	R33E-01	1
28	MOTOR COMPRESSOR STARTER (C1)	E11A-1	1
29	MOTOR COMPRESSOR STARTER COIL (C1)	SUPPLIED W/STARTER	
30	FULL COOLING SWITCH	E16A-5	1
31	FULL COOLING PILOT LIGHT - BLUE	E06B-4	1
32	HIGH PRESSURE CUT-OUT (C1)	R37B-01	1
33			
34	DESUPERHEATER TEMPERATURE CONTROL (BLIND SET)	C03A-3-2	1
35	DESUPERHEATER SOLENOID VALVE (BY-PASS) (S3)	E14E-1-1	1
36	LIQUID LINE SOLENOID VALVE (MAIN) (S1)	E14E-3-1	1
37	HOT GAS BY-PASS SOLENOID VALVE (S2)	E14E-3-1	1
38	REDUCED COOLING SWITCH	E16A-5	1
39	REDUCED COOLING PILOT LIGHT - BLUE	E06B-4	1
40			
41			
42			
43	DOOR LATCH AND STRIKE	M02-DH	1
44	DOOR GASKET - SILICONE SPONGE	M05-A3-132"	1
45	DOOR GASKET - NEOPRENE SPONGE	M05-A4-120"	1
46	DOOR GASKET - HARD RUBBER	M05-A5-180"	1
47	CHAMBER BLOWER FAN BLADE	M10-E71	1
48	SHRIVES	M04-A134	AS REQD.
49	TEMPERATURE INDICATOR	C01A-7	1
50	LOW PRESSURE CUT-OUT (C3-2)	R37C-01	1

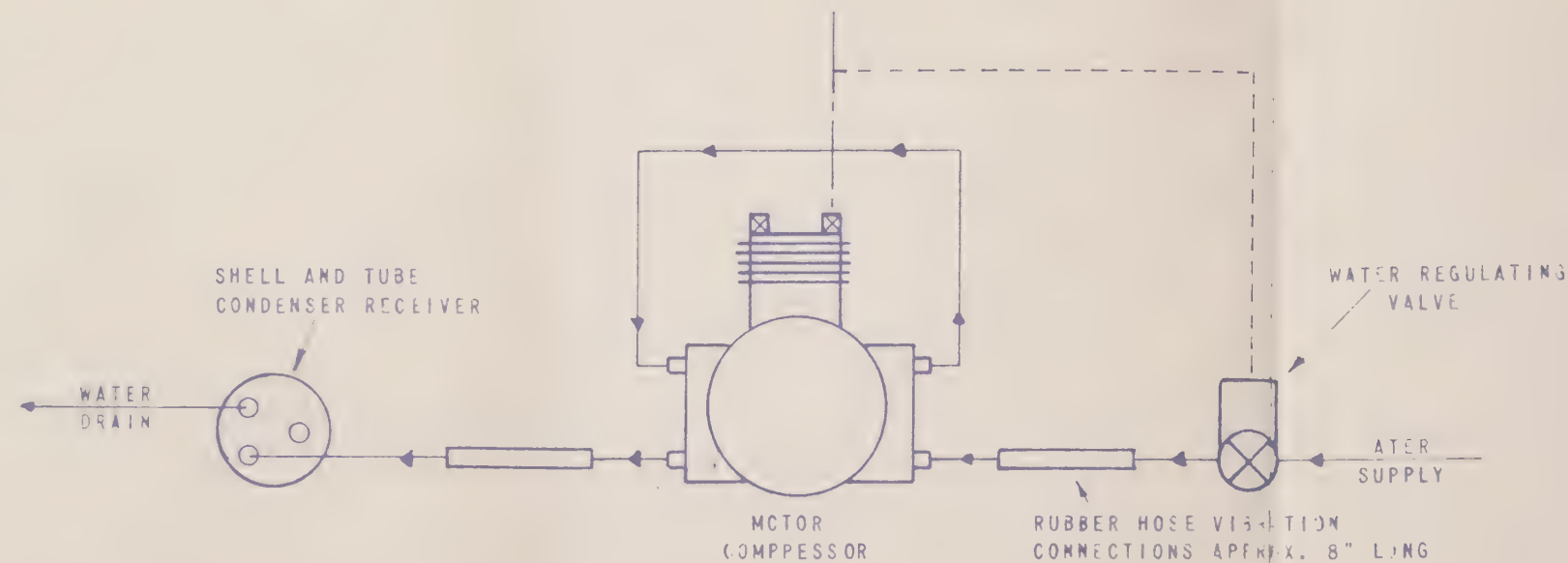
	DESCRIPTION	PART NUMBERS	QTY
51	CHAMBER BLOWER OVERLOAD HEATER	E11D-N	
52	CONTROL RELAY	E02C-6	1
53	CONTROL RELAY COIL (C5)	SUPPLIED W/RELAY	
54	COMPRESSOR OVERLOAD RELAY	SUPPLIED W/ITEM #28	
55	OVERLOAD RELAY HEATER	E11D-N	
56	OVERTEMPERATURE PROTECTION MICROPROCESSOR ASSY.	C03A-3-2	1
57	ALARM BUZZER	E01-1	1
58			
59	PERCENTAGE TIMER	C12B-2	1
60	ELAPSED TIME METER	C12G-3	1
61	RESISTOR (OTP)	E03A-5-4	1
62	OTP PILOT LIGHT (AMBER)	E06B-1	1
63	OTP RESET DEVICE	C03C-4-1	1
64			
65			
66	OTP CONTACTOR	E02F-1-1	1
67	OTP CONTACTOR COIL	SUPPLIED W/CONTACTOR	
68	BELLOWS ASSEMBLY FOR ITEM #56	C11A-4	
69			
70	CAM DRIVE MOTOR ASSEMBLY - (24 HOUR)	E10C-5-1	1
71	CAM DRIVE MOTOR ASSEMBLY - (4 HOUR)	E10C-1-1	1
72	AUXILIARY MICROSWITCH, DUAL (CAM ACTUATED)	E16E-9	1
73	CAM DRIVE MOTOR SWITCH	E16A-2	1
74	PROGRAMMER CONTROLLER	C07A-3-3	1
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87	UNIT PROVIDED STANDARD WITH 480V		
88	3 PHASE OPTION 01, QWD-911A		
89			
90			

DATE: 10-11-76 BY: EMM CHECKED: ULS

LINE NO.	VOLTAGE	AMPERES
L1	480V	11A
L2	480V	4A
L3	480V	11A

REVISION	REASON	DATE	BY

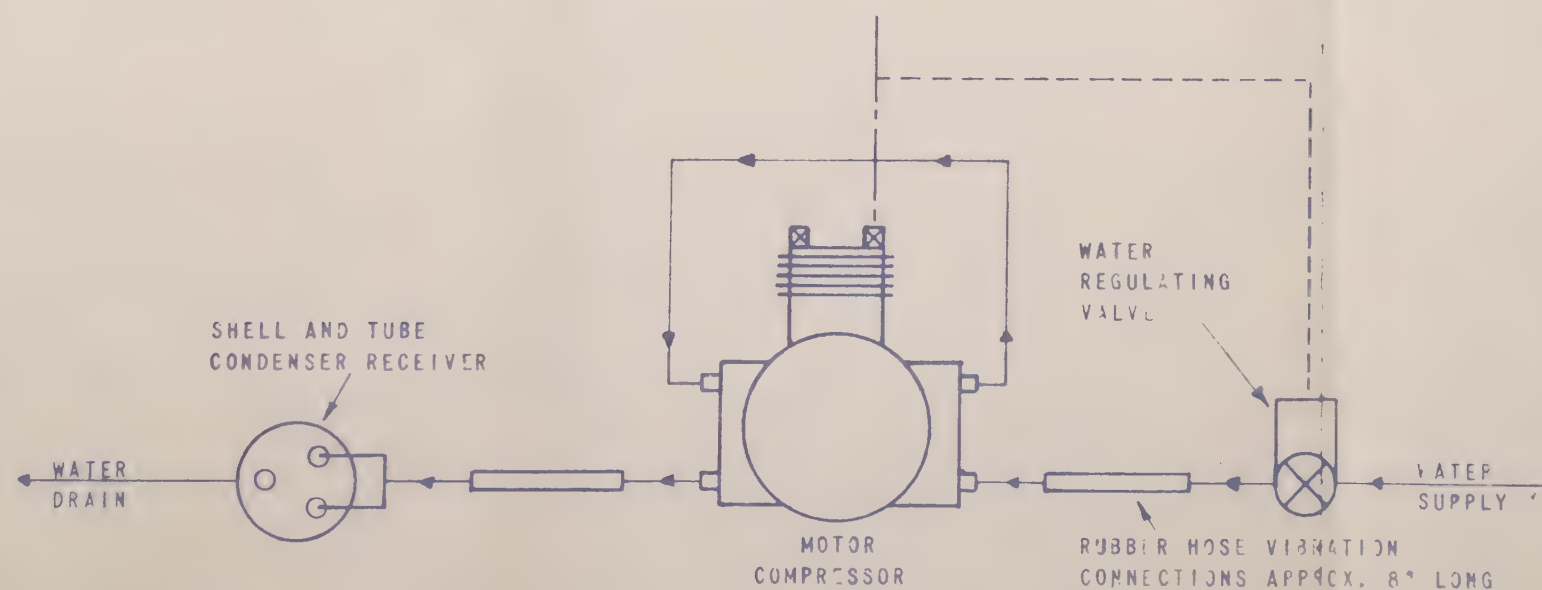
Parts shipped P O B Blue Island, Illinois - When ordering parts give Model No. Serial No., Voltage and Part No. *PARTS NOT SHOWN **OPTIONAL ACCESSORIES



SINGLE STAGE REFRIGERATION WATER PIPING
DIAGRAM FOR USE WITH CITY WATER

NOTE:

ALL WATER PIPING TO BE WITH O.D. SIZE HARD COPPER TUBING, EXCEPT FOR RUBBER HOSE VIBRATION CONNECTIONS AT COMPRESSOR AND PIPING BETWEEN WRV AND WATER SUPPLY COUPLING WHICH IS GALVANIZED PIPE FOR THE SUPPORT OF THE WRV. ALL PIPING TO BE SUPPORTED AS REQUIRED. FOR PROPER LINE SIZES, REFER TO THE STANDARD WATER PIPE SIZE CHART.

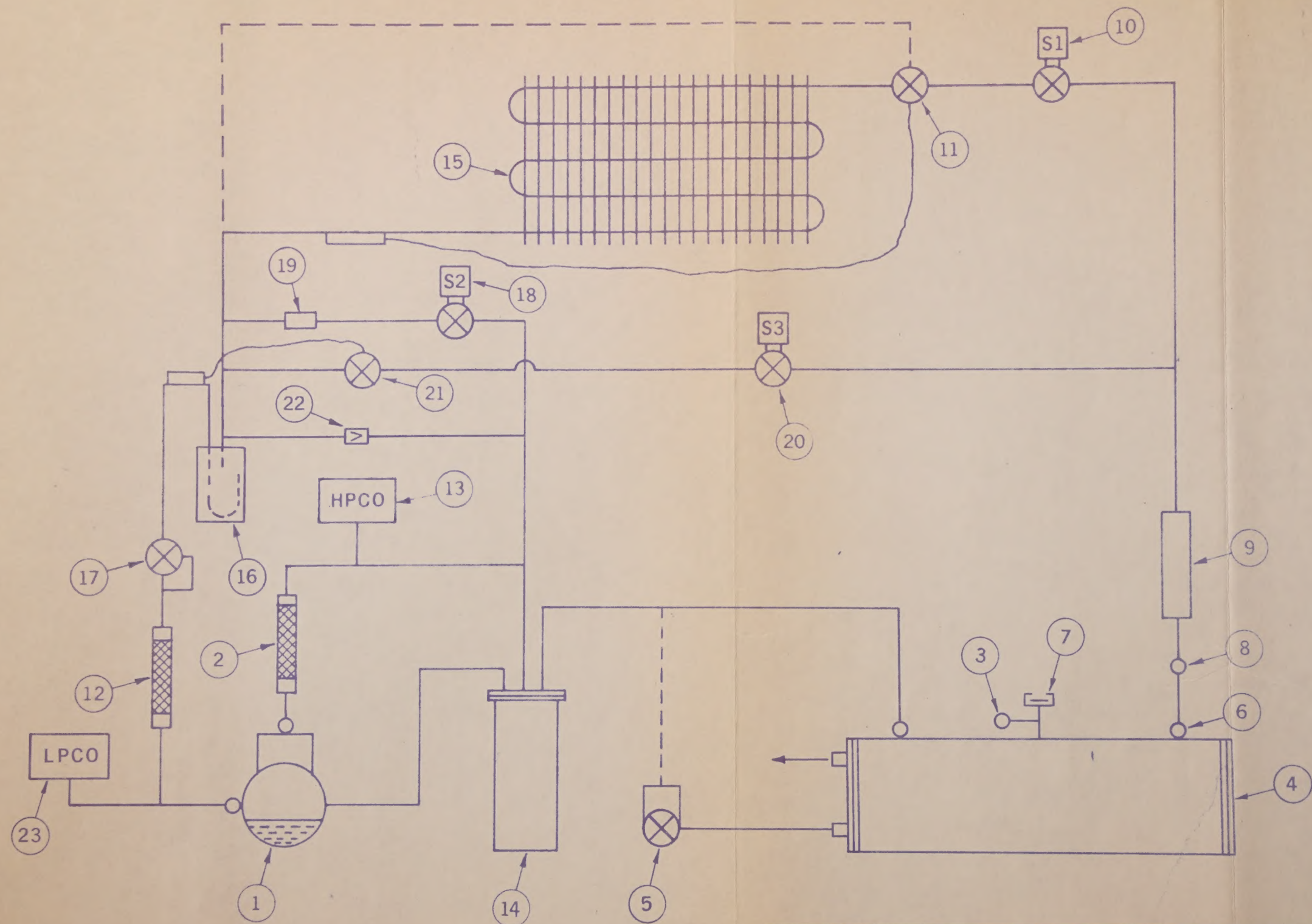


SINGLE STAGE REFRIGERATION WATER PIPING
DIAGRAM FOR USE WITH TOWER WATER

NO. J-116-13

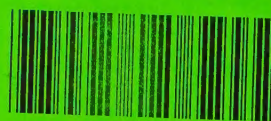
SINGLE STAGE REFRIGERATION
WATER PIPING DIAGRAMS

Date 8-11-66	Drawn by DJV	Checked by
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		 BLUE M Electric Company BLUE ISLAND, ILLINOIS 60406	
		PART NAME REFRIGERATION SCHEMATIC	
		USED ON SINGLE STAGE SYSTEMS	
A	#22 & #23 ADDED	2-20-67	SCALE - / - / -
LET			DATE 7-1-66
		DRAWN <i>[Signature]</i>	CHECKED WT
		DRAWING NO. RS-345-13	
		REV A	

MP MASTER



MA34378